

CHAPTER LXIV

THE LEAD INDUSTRY

LEAD was known, probably, to the earliest peoples of the earth. Its use antedates written history, and its abundant occurrence in nature, taken in connection with the ease with which it is reduced from its ores, leads archæologists to infer, even when little mention and few traces are found, that the ancient nations were familiar with its properties. Egypt, when the pyramids were building and the golden serpent of the Pharaohs still represented living royalty, knew the plumber's metal and used it, either as an alloy for her wondrous bronze, or in native form for small images and amulets. The armies of Thotmes III. brought it back with their spoils from Mesopotamia, and made it into sling bullets, the Egyptian slingers using it, as did the Persians, and later the invincible legions of Greece and Rome. Babylon used lead to render moisture-proof the famous hanging gardens; Troy, ere Hector fell, and Priam, saved by the most dutiful of sons, became a wanderer, made images of lead; and the Phenician mariner, steering his bark across the sea by the glittering constellation of the Little Bear, not only carried it in his hold, consigned to the great storehouses of Sidon and Tyre, but the hollow tubes of his anchors were weighted with it as well.

Greece and Rome knew lead as well as we of to-day. Conquered Britain yielded to the Roman not only the "imperial tenth," but her immense stores, which produced thousands of tons, and which Rome claimed, in fee forceful, and took. Spain also yielded the Romans thousands of tons, and the mines of the Urals were works of antiquity when Cæsar was a child. Nearly every land on earth found more or less lead within its borders, and the mining of this metal in a small way was almost universal at the time America loomed up before the European imagination as the world's El Dorado. Naturally so base a metal as lead was not the objective treasure of the adventurous miners and

metallurgists who first struck their picks into American soil. Gold and silver they sought, and if for many years they found little, their search at least developed many mines and regions, as perhaps the too easy discovery of the yellow metal they coveted might not have done.

The first American lead discovered, by white men at least, was in 1621, in the vicinity of Falling Creek, near Jamestown, the original English settlement in Virginia. Iron-smelting works had been erected by the London Company, and an expert metallurgist named John Berkeley was put in charge. Berkeley, in addition to his services rendered to the company, did a little prospecting on his own account, which developed the existence of a vein of galena—the sulphide and commonest ore of lead. He worked this secretly, and supplied his neighbors with lead for bullets and other purposes; but cupidity caused him to keep the location of the vein a secret, so that when, a year or two later, he was killed by Indians, his secret died with him. A few years later a friendly Indian disclosed the location of the old mine, and the lead deposits of Virginia have been worked more or less ever since, although the output has never been very great. Lead was also early discovered in Connecticut and Massachusetts, and by the middle of the last century valuable workings were open in New York State. The lead-mines of the East, however, have never been of such importance as those of the great central and Western regions of the Upper Mississippi and in Missouri, which were early developed by the French. The lead-fields of the Galena district, comprising portions of Iowa, Illinois, and Wisconsin, which have been among the most productive in the world, are believed to have been first discovered and worked by an Indian trader named Nicholas Perrot, who explored from the Canadian settlements of the French as far as the river Des Moines during the last of the seventeenth century. By 1690 the Indians living in the

regions about Galena were smelting and selling lead to the French traders. The region contiguous to the present city of Dubuque, which was one of the richest lead districts in America, was also first worked by a Frenchman, Julien Dubuque, who settled among and made friends with the Sacs and Foxes in 1774, just prior to the Revolution.

The Indians in 1788 granted to Dubuque the mine he had discovered, known as *Prairie du Chien*, and in 1796 the grant was confirmed by Baron de Carondelet, the French governor-general of the tract called Louisiana, which included the present States of Missouri, Arkansas, Mississippi, Louisiana, parts of the States of Kentucky, Tennessee, and Illinois, and all the broad lands to the westward. Dubuque worked his mines until his death, in 1809, when the Indians, after burying him with tribal ceremonies in a massive leaden coffin on the great bluff which bears his name, reclaimed them from Dubuque's creditors, and held possession until their removal from the district, in 1832, by the United States government. Dubuque's heirs at once claimed the property, but the government ejected them; and legal squabbles kept the status of the district in a most uncertain condition until 1847.

The mine *La Motte*, upon the head waters of the St. Francis River, a great lead property, was also discovered by a Frenchman, the famous adventurer and explorer, M. de la Motte-Cadillac, who founded Detroit. *La Motte* discovered the celebrated *Golden Vein* sometime between 1715 and 1719; but authorities differ as to the precise year, William H. Pulsifer, in his "*Standard Notes for a History of Lead*," seeming to incline to the former date. The lead-fields in the vicinity of Potosi, Mo., were discovered about 1720 by Philippe François Renault, and in 1763 the extensive fields known as *Mine à Burton* were discovered by Francis Burton, who in 1798 granted about one third of his claim to Moses Austin. The latter erected improved furnaces for smelting, sunk the first shaft ever seen in a lead-mine in that district, and began the manufacture of shot and sheet-lead. Around this industry grew up the town of *Herculaneum*.

The condition of the lead-mining interests of the country in 1795, when the century of which this paper properly treats began, was as outlined above. Minor workings in the Eastern States, while they produced but a comparatively small output, were the only really American interests.

France and Spain, with their respective territories of Louisiana and Florida, had jurisdiction over nearly all the valuable mining lands of the lead

region; and even in those districts where the United States had acquired rights, the mining privileges were usually in the hands of the French and Indians, who recognized their value and were slow to part with them. The Indians, in particular, made the rich surface sheets of galena a source of continual profit. Their methods of smelting were crude in the extreme, consisting usually of a small hole dug in the ground and lined with rocks. This was usually located on a side-hill, both for the purpose of getting a strong air-draft, and also in order that a small tunnel connecting with the bottom of the furnace-hole might be dug, through which the molten lead could run off when the galena and fuel were thrown in and fired. Rough pigs, run in a scooped-out hollow of the earth itself, and weighing about seventy-five pounds, were usually made by the Indian squaws and taken to the trading-posts for barter. This method of smelting was wasteful, but with the practically unlimited supply it made little difference, and almost any man who found either a pocket of the "float" mineral or a small vein could mine and smelt it roughly himself. As the surface deposits became exhausted, and the miners had to go deeper, while at the same time improved and economical methods of reducing the ore became necessary, more capital was required and the works became more extensive.

There is probably no ore that reduces more readily than galena, yet at the same time the volatility of the molten lead permits great loss from careless methods. The composition of the ore, which, as before stated, is a sulphide, is about eighty per cent. of lead, frequently carrying more or less silver, and sometimes nickel, cobalt, or antimony, with about seventeen per cent. of sulphur. Simple roasting suffices for its reduction, the sulphur combining at a low temperature with the oxygen of the air, and passing off. This is, in its simplest statement, the process by which lead is extracted from this ore; and either open furnaces with strong draft, or reverberatory furnaces, are used. Unfortunately a considerable quantity of the lead passes off in fumes from the furnace. In remedying this, some of the modern smelting-works have found it profitable to build a very long funnel-pipe, through which the fumes from the furnace are passed before they reach the air. During this passage they are cooled, and a very appreciable quantity of lead in the form of powder is deposited along the pipe.

Another and great discovery was not made in this country until 1838, when cerussite, or the lead carbonate, was found by the American miners to be

reducible and a valuable ore. This ore, previously thrown away by the miners, who called it "dry bone," was found in large quantities, and its utilization very greatly increased the annual output during the decade following. Under this stimulus, and the litigation over the more important lead regions having been settled, the output of the mines in the Galena district jumped from 664,530 pounds in 1825 to 54,494,856 pounds in 1845. The decade between 1840 and 1850 witnessed the high-water mark of the lead interests in America up to the time that the Western lead-fields were opened. The rich properties of the Mississippi and in Missouri yielded plentifully, and in their eagerness the mine owners allowed themselves to glut the market, with the inevitable result that prices fell and the entire lead industry received a set-back from which it was some years in recovering. The Jasper County lead-fields, which have built up the town of Joplin, Mo., were also discovered during this decade, in 1848. Operations were carried on in a small way, but no general attention was attracted to this district until a dozen years later, when, in three years, 17,500 tons were produced from these mines. Since then the annual output has been as great as 17,765 tons, and in one year (1884), the disastrous one for all lead interests, as little as 2665 tons.

American lead-mines held but a poor third place among the productive fields of the world, however, until well into the seventies. England and Spain each produced greater quantities of lead than the United States in 1872; but the development, about this time, of the great Western deposits of argentiferous galena, which had been discovered in 1864, changed all this. This rich region, neglected on account of its inaccessibility to a market, suddenly took on life and activity with the extension of the railroads through the territory. In 1877 the Eureka district was turning out nearly 20,000 tons of lead annually; the Utah lead-fields, worked by the Mormons, were producing 15,000 tons annually so early as 1873, and by 1877 the output had increased to 27,000 tons for the year. Colorado was a year later in showing respectable results for her workings, but by 1883 the output of the mines of that State amounted to the tremendous total of 70,557 tons. This marvelous increase was largely due to the cerusite deposits at Leadville, which were first worked in 1878, and from which fully one half of the total lead production of the State was derived.

These Western lead ores were, almost without exception, very rich in silver. While silver in small quantities is found in all galena, and has been ex-

tracted even from the ores of the Mississippi and Missouri lead regions in quantity ranging from six to twenty ounces per ton, it was only in the Western mines that the precious metal was found in quantity sufficient to make the lead a by-product so far as relative values were considered. So little was thought of lead, in fact, that in the earlier days, when transportation was more difficult and expensive, the ore was cupeled at the mines, and only the silver brought to market. For this reason the lead output has been more or less dependent upon the silver market, but this is beginning to change. Lead itself has gained a place in the useful arts and manufactures that cannot be ignored, and its supply must be maintained. Owing to this the production of the American mines has been developed to a point far in excess of the figures of twenty years ago. The year following the development of the Western argentiferous deposits the United States was producing as great a quantity as was England in 1872, when she was the great lead miner of the world. Less than ten years later the annual output of the American mines had reached a figure greater than the combined production of England, Spain, and the United States in 1872, and the increase was steadily maintained.

In the foreign commerce of the nation lead has, within the past five years, come to play a far more important part than it ever did before. In 1885 the imports of lead and its manufactures were only \$486,436, and the exports \$123,466. In 1890 the figures had only increased to \$657,658 for the imports and \$182,412 for the exports; but the very next year saw a marvelous advance, which has continued ever since. The importation of silver-bearing ores, containing much lead, has also become an important matter, and until the silver repeal bill was passed, and the "bull" days for that metal ceased, Mexico had a great interest in that direction. The figures for the past five years, excluding 1895, for which full reports are not yet published, are as follows:

VALUE OF LEAD IMPORTS, 1890 TO 1894.

YEAR.	LEAD, AND MANUFACTURE OF.	SILVER-BEARING ORE.
1890	\$657,658	\$7,748,572
1891	2,500,886	8,953,608
1892	3,653,378	9,656,761
1893	5,792,624	11,100,747
1894	6,606,865	6,679,171

The exports during the same period show only a comparatively slight gain, having ranged from \$182,412 in 1891 to \$638,636 in 1894.

During the sixty-five years between 1825 and 1890 the production of the lead-mines of this country amounted to the almost incredible total of 5,324,794,000 pounds, or, expressed in the briefer figures of commerce, to 2,662,397 tons. The product, as summarized for the same period by the demi-decades, will give, if the previous explanation of causes is borne in mind, the best illustration of conditions, rise, and progress in the lead industry that can be drawn. Up to 1873 lead was almost entirely obtained from the non-argentiferous ores of the Missouri and Mississippi regions; but after 1875 the table specifies the relative quantities from the two grades of ore. The figures given are in the standard short ton:

PRODUCTION OF LEAD, 1825 TO 1894.

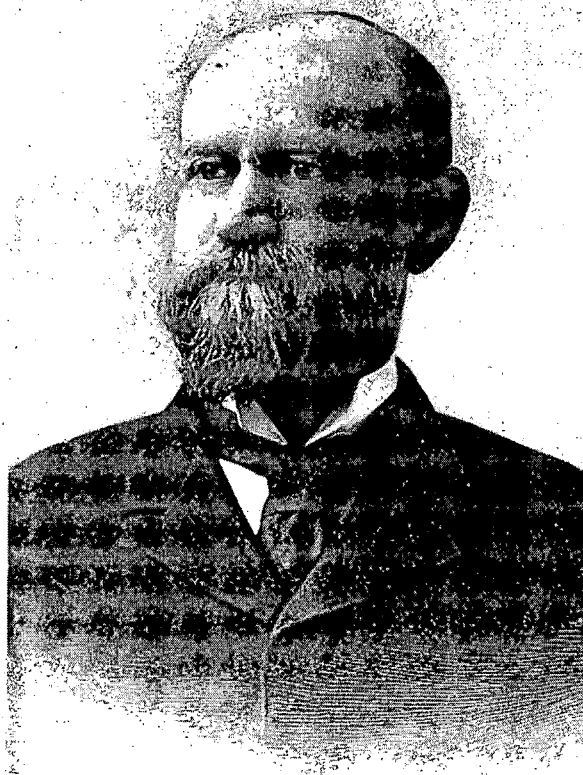
YEAR.	TOTAL.	NON-ARGENTIFEROUS ORE.	ARGENTIFEROUS ORE.
1825 .....	.....	1,500	.....
1830 .....	.....	8,000	.....
1835 .....	.....	13,000	.....
1840 .....	.....	17,000	.....
1845 .....	.....	30,000	.....
1850 .....	.....	22,000	.....
1855 .....	.....	15,800	.....
1860 .....	.....	15,600	.....
1865 .....	.....	14,700	.....
1870 .....	.....	17,830	.....
1875	59,640	24,731	34,909
1880	97,825	27,690	70,135
1885	129,412	21,975	107,437
1890	161,754	31,351	130,403
1892	213,262	31,678	181,584
1894	159,331	37,686	121,645

In the production of the 161,754 tons of metallic lead in 1890 the smelting and refining works employed 6131 men, to whom was paid in wages for the year \$4,228,634.15. This sum, together with \$5,154,682.04 paid out for supplies and materials, and other charges incidental to the carrying on of the business, brought the total expenditures for the year to \$11,457,367.25.

Between lead crude, and cast or hammered into some required form, and lead manufactured, chemically changed, and metamorphosed, there is a great break in time. The chief of all the products of lead manufacture is, of course, the carbonate, which was the psmitium of the Greeks, the cerusa of the Romans, and is the white lead of to-day. As a pigment and base for colors it finds its chiefest use, its well-known body and opacity and ready assimilation with linseed-oil, which is the best of all vehicles for coloring-matters, making it the best substance man has yet discovered for this purpose. Other important lead products are litharge, the yellow

protoxide; minium or red lead, which is a combination of the protoxide with a peroxide; orange mine or orange mineral, made by heating white lead; and lead acetate or sugar of lead. There are several other forms in which lead combines, but the substances already given are those of most importance in the arts.

In point of antiquity the oxides seem to have been longer used than the white lead, no traces of which are found in the wall-paints of the Egyptians, Hindus, or other ancient peoples; whereas the oxides are found to have been used both for the glazing of pottery and in colors. White lead was first brought into extended use by the Romans; and Rhodes, the manufacturing center of antiquity, was the place from which the finest was obtained. Roman women used the ceruse as a cosmetic—a use it also found among the Athenian belles; and minium was used as rouge. In these peculiar uses, despite the well-known injurious qualities of lead, the same substances have remained up to a comparatively recent date. White lead was also used by the Romans as a body for their paints, and both it and its manufacture are described by such ancient writers as Theophrastus, about 300 B.C.; Vitruvius, who wrote about two hundred years later; and Pliny and Dioscorides, who filled respectively the records of the two succeeding centuries. These writers all agree in stating that white lead was produced by placing sheets of lead in pots with vinegar or wine lees, and allowing them to stand. This fails to account for the presence of the carbon dioxide necessary to the reaction which converts the lead acetate to the carbonate; but it is certain that this substance was present, for the product was unquestionably white lead. During the dark ages, and up so far as the sixteenth century, there was but little use for white lead. About the latter date its manufacture was begun in Holland by what is now known as the "Dutch process." This process, however, can scarcely have been original with the Dutch, since Theophilus, a monk who wrote about the tenth century, describes it very exactly, and the Saracens, Italians, and Spaniards are all said to have used it. With the addition of stable litter banked around the jars, in which small bits of marble are also placed, the Dutch process differs in no way from that described by Pliny, who says: "The lead is thrown into jars filled with vinegar, which are kept closed for ten days; the sort of mold which forms upon the surface is then scraped off, and the lead is again put into the vinegar until the whole of the metal is consumed."



WILLIAM P. THOMPSON.

The Dutch process, whether it dates from Amsterdam or Rhodes, has ever since, however, been the one which, in its elemental principles, but with improvements and technical modifications from time to time, has proved the best and most profitable. Holland became skilled in this manufacture, and England had already established it firmly upon her own tight little island at the time when the century under discussion opened. America, on the other hand, had not one establishment for the manufacture of white lead. What white lead was used during the eighteenth century came from England; but the primitive habits of the community in those early days caused paint to be regarded not only as a luxury, but, furthermore, as a useless one, since timber was far too plentiful and cheap to require preservation at the expense of paint. Neither inside nor out were the buildings of the early colonial townspeople painted, and the log cabins of the settlers needed little such adornment. After the Revolution, however, more luxurious customs and greater pretensions were indulged in by the citizens of the new Republic, and the use of paint became general in the cities. For the body of this paint all the white lead had to be imported from England. The English product at this time was most unblushingly and heavily adulterated, and prices were more than high. So great did the demand become, and so profitable the business to the English manufacturers, that when the manufacture of white lead was proposed and commenced in the United States, the most desperate attempt, resorting to means beyond even the lawful limits, was made to ruin the new American industry. Had it not been for the War of 1812 and the consequent shutting out of British goods, it is highly probable that the white-lead industry would have been delayed for many years in this hemisphere.

The original manufacturer of white lead in the United States was Samuel Wetherill, of Philadelphia, who was also one of the earliest woolen, cotton, and general chemical manufacturers. This enterprising gentleman, who was one of the most prominent members of the Pennsylvania Society for the Encouragement of Manufactures and the Useful Arts, which was established in 1787, began the manufacture of white lead early in the present century. Concerning the exact year authorities differ, —some so widely as to place it in 1789,—but Mr. Pulsifer, to whose "Notes for a History of Lead" I have before referred, takes the authority of a descendant of Mr. Wetherill, and dates the first lead manufactory in the United States from 1804.

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Shortly after the factory was opened a young Englishman applied for work. A night or two later the factory was destroyed by fire, and the young Englishman left that very morning for England. Gossip always connected the two events. About 1809 the factory was rebuilt, and then began the bitterest struggle any two great commercial interests here and in England ever waged. British lead was put on the market at a price that was absolutely impossible for the American maker to quote. The War of 1812 saved Wetherill from ruin, and under the impetus thus given the industry grew rapidly for a few years, its growth being still further aided by the development of the recently acquired lead regions that Louisiana, as purchased from the French, included. By the census of 1810, Wetherill's factory, which was the only one in the country, was credited with an annual product of 369 tons. Red lead was also produced in small quantities, but the imports of these two products exceeded the domestic production as two and one half to one. In Philadelphia, where the industry began, the second factory in the country was started by John Harrison, at the Kensington Works, about 1810. In the latter year the manufacture of white lead was begun at Pittsburg by Adam Bielin and J. J. Stevenson. A second factory in the same town was started, but proved unsuccessful after a year or two. Meantime an Englishman named Smith appeared in Philadelphia as a manufacturer of white lead, and all five of these firms were struggling against the English manufacturer when the War of 1812 came to their relief.

All of these early manufacturers employed, so far as can be learned, the Dutch process, as previously described. Certain patents for improvements upon it were taken; but the burning of the Patent Office has destroyed all record of them, except that Samuel Wetherill devised and secured a new and better method "for setting the beds or stacks." Stable litter as the source of the required heat was in universal use. Various new and speedier methods for the manufacture of white lead than those provided by the Dutch process were invented, and in 1814, Welch & Evans, of Philadelphia, patented one by which granulated lead, placed in revolving lead-lined barrels partly filled with water, was ground by attrition, oxidized by the air, and carbonized by the addition of burning charcoal. A factory for the manufacture of lead by this process was built soon after by a Mr. Richards, who had succeeded the Englishman Smith. The venture, like all similar ones, proved unprofitable.

The price of white lead before the War of 1812

was from ten to twenty cents per pound. American manufacturers mainly used the imported pig-lead, and the domestic supply was small. When the importation of the foreign pig-lead was suspended by the war, the price of the native metal took a great jump. The Western lead-fields, however, were either undeveloped or, as in the case of the rich Galena district, still in the hands of the Indians; and a great scarcity of the metal resulted, which caused the price of white lead to advance to thirty cents a pound. The profit inevitably suggested by these figures, together with the general resumption of business that came after peace was declared, gave a fresh impetus to the white-lead industry. During the next twenty years many new works were established, and older ones extended. By 1830 there were twelve establishments in the country, of which eight were east of the Alleghanies. These factories were not turning out over 3000 tons annually, and as the price of white lead, following a temporary glut of the pig-lead market, had declined to nine cents per pound, the total value of the year's output was but a little over \$500,000.

One of the great advances made in the manufacture of white lead in this country came about two years after this, when Augustus Graham, a prominent New York manufacturer of white lead, discovered, by obtaining employment as a common workman in one of the great English factories, the secret of the use of spent tan-bark instead of stable litter as a means of obtaining heat and carbonization. This knowledge worked a considerable change in white-lead manufacture, and by 1840 the annual product had increased about sixty-six and two thirds per cent. in the whole country. Prices, however, had advanced but little, white lead being quoted at only a cent a pound more than in 1830. The sudden bursting forth into prosperity and productivity of the mines in the Galena and Missouri lead regions, which occurred during the fifth decade, had an immediate effect upon the white-lead industry. The supply was unlimited, but the question of transportation was a serious one. Waterways were, of necessity, considered the only freight routes available, and Europe was far nearer to the Eastern cities than those towns situated to the westward of the great bar of the Alleghanies. From the Missouri lead-fields, and the Galena region as well, the pig-metal was boated down to New Orleans, and there transhipped by vessel to New York. Not only was it a long journey, but it was a costly one as well; and in some sections, not readily within the distributive field of New York or the large coast

cities, other means were adopted. At Buffalo, especially, I recall the method of transportation by which the Galena district pigs were landed at the factories of the corrodors. The manufacturer had to keep an agent at the mines, and buy daily, as auctioned off, the product of the day's smelting. When an agent had thus purchased a sufficient quantity he secured a caravan of prairie-schooners drawn by oxen, and started it across the open prairie to the nearest settlement and lake port, Milwaukee, where the lead was shipped in sailing vessels and taken to Buffalo.

The ten years preceding and those during which the Civil War was raging marked no important advance in the lead industry. The introduction of the manufactured zinc oxide as a substitute for white lead, together with the advance in the price of metallic lead under the strong influence of the war-time demand, checked the use of the manufactured product until the return of better times at the conclusion of the war. Furthermore, adulteration, which had long been regarded as permissible by white-lead makers, came to the condemnation it deserved, and the purer product developed by this sentiment had its immediate effect in raising the manufactured lead in the public estimation. It was about this time, also, that "sublimed lead" came to be introduced for use as a substitute for white lead. The discovery resulted from certain unsuccessful experiments made by two gentlemen named Lewis and Bartlett, in the direction of an improved and speedier process for manufacturing white lead. It is a singular fact that the manufacture of white lead is one of the few of the useful arts in which modern science has so far been able to make little appreciable advance. The monkish presbyter Theophilus, in the ninth century, knew, as did the Rhodians before him, and the Dutch nearly seven hundred years after him, the basic principles of the manufacture of white lead; and if the empirical knowledge of that early day has been replaced by formulated knowledge, it still has accomplished but little to recompense its added learning. Englishmen, Frenchmen, Germans, and all other nationalities have experimented with the subject abroad, and Americans have invented and patented at home, but all to no purpose. The original Dutch method, with certain improvements in detail and manipulation, seems destined to survive this century, as it has the many before it.

The white-lead production of the United States, as followed by decades from 1810, while it can only be given for much of the time in approximate

amounts, is still sufficiently exact to show the steady growth which has brought it to prosperity and prominence in the industrial affairs of the nation. As accurately as can be obtained, the figures are:

WHITE-LEAD PRODUCTION, 1810 TO 1890.

YEAR.	TONS.	YEAR.	TONS.
1810.....	369	1860.....	15,000
1820.....	...	1870.....	35,000
1830.....	3,000	1880.....	50,000
1840.....	5,000	1887.....	65,000
1850.....	9,000	1890.....	75,000

The lead oxides, of which a considerable quantity is annually produced in the United States, were, like white lead, first manufactured in the western hemisphere at Philadelphia, where, before the War of 1812, there were at least three establishments. Their manufacture has changed little during the last one hundred and fifty or two hundred years, during which time they have been recognized products of the English factories, and have also been made in Holland, and to some extent in France. In making red lead, which is, perhaps, the most important of the oxides, the method is simply to heat litharge in a reverberatory furnace, which immediately changes it from yellow to red. In this country this method is the one commonly employed, although some works substitute a bottle-shaped iron cylinder for the reverberatory furnace. Red lead and litharge are usually manufactured at the white-lead works, and there are but few separate establishments for the exclusive manufacture of the lead oxides. Orange mine or orange mineral, a form of lead oxide produced by heating white lead, is another of the useful products of the metal; and the valuable astringent known in medicine as sugar of lead, and chemically as acetate of lead, being obtained by the simple treatment of lead with acetic acid, and without the presence of carbon dioxide, is still another product well known to the commerce of to-day.

The personnel of the white-lead industry since its establishment in 1804 has been an interesting one, and has included many men of the rarest business abilities and most unswerving integrity. For a comprehensive summary of it up to within ten years I acknowledge my indebtedness to the author of "Notes for a History of Lead." According to this authority there were, outside of those firms already mentioned, only two established during the second decade—the Cincinnati Manufacturing Company in 1815, and Barney McLennon's works, in the same

city, in 1820. Dr. Vanderberg, of Albany, was experimenting with its manufacture by improved processes in New York in 1820; and ten years later, having come back from experiment to the old-time Dutch process, he, together with David Leavitt and John and Augustus Graham, under the title of the Brooklyn White-Lead Works, were operating successfully. This company was incorporated in June, 1825. Another Brooklyn firm of early establishment was the Union White-Lead Company, started by the Messrs. Cornell about 1827. The Salem Lead Company in 1824, and Francis Peabody in 1826, established the white-lead industry in Salem, and Robert McCandless and Richard Conkling established works in Cincinnati during this same decade. In 1830 there were about a dozen white-lead factories in the United States, and eight of these were east of the Alleghanies, including, besides those just mentioned, Lewis & Company, Wetherill & Sons, Harrison & Brothers, of Philadelphia, and Hinton & Moore, of New York, who also handled large quantities of the imported article. During the next decade there were started the Boston Lead Company, in 1831; Great Falls Manufacturing Company, in 1832; Jewett, Sons & Company, at Saugerties, in 1838; Gregg & Hagner, at Pittsburg, in 1837; and Reed & Hoffman, at St. Louis, in 1837. This latter establishment, taken shortly afterward by Henry T. Blow, became in later years the Collier White-Lead and Oil Company.

From 1840 to 1850 was a period of the most rapid growth for the white-lead industry. Among the larger works established during this decade were: the Atlantic White-Lead Company, of New York, founded by Mr. Robert Colgate; John Jewett & Sons' Staten Island works; the Great Falls Manufacturing Company, changed by Batelle & Renwick to the Ulster White-Lead Company; Suffolk Lead-Works and Norfolk Lead Company, of Boston; the Forest River Lead Company, of Salem, successors to Francis Peabody; Thompson & Company, of Buffalo; B. A. Fahnestock & Company, of Pittsburg; Eagle White-Lead Works, at Cincinnati; and William Glasgow, Jr.'s, works, at St. Louis.

The succeeding decade saw less increase than the one preceding. William Wood and T. J. McCoy took the Eagle Works, of Cincinnati; the Niagara White-Lead Company started at Buffalo, and Wilson Waters & Company at Louisville. This was but a lull, however, that was to give place to renewed activity. From 1860 to 1870 there were founded, among others, such great establishments as the St. Louis Lead and Oil Company, which succeeded the

O'Fallon White-Lead and Oil Company in 1865; the Southern White-Lead Company, established by Platt & Thornburg in the same year; Goshorn Brothers, who secured the McCandless establishment in Cincinnati, and afterward organized it as the Anchor White-Lead Company; the Eagle White-Lead Company, also of Cincinnati; the Shipman White-Lead Company, organized at Chicago by D. B. Shipman; J. H. Morley's works, at Cleveland; Haslett, Leonard & Company, who succeeded Waters in Louisville; Lewis & Schoonmaker, of Louisville, who later sold out to T. J. McCoy and the American White-Lead Company; the Western White-Lead Company, in Philadelphia; the Cornell Lead Company, which succeeded the Niagara Company, at Buffalo; four branch establishments of Fahnestock & Company, at Pittsburg; Hall, Bradley & Company, of New York and Brooklyn; the Salem Lead Company, a new company organized by Mr. Francis Brown at Salem; and the Maryland White-Lead Company, which was established in Baltimore in 1867. In Cincinnati Frederick Eckstein became interested in the business of Townsend Hills.

Since this period there have been comparatively few large establishments founded. Even so early as 1870 the tendency toward consolidation rather than individual extension was already noticeable, and the two largest of the plants founded during the succeeding decade were both absorbed by the older companies.

The manufacture of white lead in former years had been very profitable, which had induced the building of an unnecessarily large number of factories in different sections of the country, which in turn brought on severe competition, and many of the factories became unprofitable. In order to lessen this competition various devices of association were successively tried, and failed, until at last, in 1887, a number of factories came together in an association practically similar to the then existing Standard Oil Trust. The association, however, was unsuccessful, and in 1889 my friends H. H. Rogers and the late Charles M. Pratt, both of whom had had large experience in the lead and paint business, knowing that I was about to retire from my association with the Standard Oil Company, called my attention to the fact that the National Lead Trust were desirous of my becoming interested with them. At that time the suggestions were declined, because of the totally inadequate capital of the existing concerns, the extreme and foolish capitalization, and the disorganized condition of the management.

Subsequently arrangements were made by which other great factories of the country, consisting of the John T. Lewis & Brothers Company, Philadelphia; the Salem Company, of Boston; the Atlantic Company, of Brooklyn; the Collier and Southern Companies, of St. Louis, including the Southern Company, of Chicago, and the Maryland Company, of Baltimore, were acquired. These properties came in, necessarily, on the same basis of capitalization as in the preceding organization. The writer then became president, and shortly thereafter acquired the important works of Armstrong, McKelvy & Company and the Davis-Chambers Company, at Pittsburg; and by the end of that year the then National Lead Trust manufactured about eighty per cent. of the country's production of white lead, seventy per cent. of red lead, fifteen per cent. of linseed-oil, ten per cent. of sheet-lead, nine per cent. of lead pipe, and sixty per cent. of lead acetate, together with sundry other of the important manufactures of lead. These, together with the large smelting and refining plant at St. Louis, smelters at Socorro, N. Mex., and Leadville, Colo., and sampling-works in different parts of Mexico, were included in the great organization with which the lead industry of this country entered upon the last decade of the century.

The real work of consolidation, sifting out, and practical organization may be said to have then fairly commenced. Many small factories operating in a desultory way, with frequent stoppages, were closed for good; works in favorable localities, and capable of producing the best results in any one direction, were devoted to this branch, enlarged and improved, and the best class of employees selected and taken to the more important works. New machinery and more healthful appliances were at once put into use. Schools for mutual education among the more important manufacturers were organized, and the expert knowledge of each placed at the service of all.

Efforts to reduce the unwieldy capitalization culminated successfully in 1891, when the Lead Trust was dissolved, and a new company, organized under the laws of the State of New Jersey, with a capital of \$15,000,000 preferred and \$15,000,000 common stock, took its place. Before the organization of the National Lead Company all the floating debt of the various corporations included in it had been paid off, and soon after its organization the large mortgages which had existed upon some of the works were liquidated, and the National Lead Company enjoys the unique position of never hav-

ing borrowed a dollar. Economics have been introduced in every department, and the character of all manufactured products marvelously improved, and at the same time placed upon the market at prices lower than ever before known, and the fact demonstrated that honest management in a combination of interests is of greater advantage to the shareholder for profit, and to the public for cheapness, than an unintelligent system of piratical competition.

With practically the same methods as those employed by the ancients, the industry has risen, through the sheer executive intelligence of the present age, until it has assumed the proportions seen to-day. Less than a century old, the lead industry in America ranks with that of any nation in the world; and from our boundless mineral resources will probably some day be drawn the greater part of the world's supply.

M. P. Thompson

